CHAPTER 4
REPORT COMPONENTS

4-1. General.

a. This chapter describes the components of the recommended format for the RA report and details the information that should be included in each component. The components are divided into the following:

(1) Abstract

(2) Section 1: Introduction

(3) Section 2: Operable Unit Background

(4) Section 3: Construction Activities

(5) Section 4: Chronology of Events

(6) Section 5: Performance Standards and Construction Quality Control

(7) Section 6: Final Inspection and Certifications

(8) Section 7: Operation & Maintenance Activities

(9) Section 8: Summary of Project Costs

(10) Section 9: Observations and Lessons Learned

(11) Section 10: Operable Unit Contact Information

(12) Section 11: References

(13) Appendix A: Cost and Performance Factors

(14) Appendix B: Project Costs

b. The RA report should be straightforward and easily understood, using consistent CERCLA terminology where applicable. The report length should generally not exceed twenty pages, excluding appendices, relying on brief descriptions for each report component. Tables and figures that support the report may be inserted within the text, at the end of each section, or collectively at the end of the report. An example RA report abstract is shown in Exhibit 4-1. Examples for other report components are provided in the following chapter sections that describe each component.

Exhibit 4-1

Example Abstract

Site Name and Operable Unit:	U Creosote Superfund Site, Operable Unit 2
Location:	Live Oak, Florida
Regulatory Oversight:	U.S. Environmental Protection Agency Region IV Florida Department of Environmental Regulation
Contractor Oversight:	U.S. Army Corps of Engineers, Jacksonville District
Remedial Action Contractor:	Cleanup, Inc., Cleantown, FL
Waste Source:	Sludge and soil contaminated with lumber treatment chemicals (including creosote and small amounts of pentachlorophenol)
Contaminants:	Polycylic aromatic hydrocarbons (PAHs) designated as total carcinogenic indicator chemicals (TCIC), including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-c,d)pyrene Pentachlorophenol (PCP)
Technology:	Land Treatment: ♦ Contaminated soil with TCIC contractions <5,000 mg/kg was excavated and placed in 4- to 12-inch-thick lifts and inoculated with PAH-degrading microorganisms. ♦ Composite samples were collected from subplots each quarter, until TCIC concentrations were detected at less than 100 mg/kg. ♦ Upon confirmation that cleanup goals had been met, the site was backfilled with clean soil and revegetated. ♦ Groundwater at the site is to be monitored for five years.
Cleanup Type:	Full-Scale
Purpose/Significance of Application:	Land treatment designed to reduce TCIC concentrations to 100 mg/kg within two years of initial placement and inoculation.
Type/Quantity of Media Treated:	8,100 cubic yards of contaminated soil were land treated
Period of Operation:	Land treatment: 1/19/97 to 7/24/98 Groundwater monitoring: Ongoing
Regulatory Requirements/ Cleanup Goals:	Soils >100 mg/kg, but <5,000 mg/kg TCICs to be land treated to 100 mg/kg. Remediation objectives to be met within two years or progress shown toward meeting objectives. If this could not be shown, alternative measures would be considered. Five years of groundwater monitoring to be implemented upon completion of construction.
Results:	Sampling conducted in June 1998 indicated that TCIC concentrations were <100 mg/kg, ranging from 23 to 92 mg/kg in the eight subplots. Cleanup goals were attained within 18 months of land treatment startup.

Exhibit 4-1, cont.

Example Abstract

Costs:	Total actual cost = $435,523 with RA capital costs of $303,026 and RA operating costs of $132,497. Total estimated remaining O&M cost = $21,000 for five years of groundwater monitoring. The technology-specific unit cost of land treatment was calculated at $33.73 per cubic yard.
Description:	From 1948 to 1986, the ABC company operated the U Creosote site as a lumber treatment facility. Lumber treatment processes included the pressure-treatment of lumber products. Small rail cars were used to move lumber to two treatment cylinders. A mixture of either creosote and water or PCP and petroleum was used to treat the lumber. The treated lumber was dried on racks over bare soil and stored in an area north of the treatment cylinders. The results of a remedial investigation/feasibility study (RI/FS) conducted at the site between 1992 and 1996 confirmed that soils and sediments in the lagoon and drainage ditch were contaminated with polycyclic aromatic hydrocarbons (PAH). During the RI/FS, EPA and the PRPs agreed to address the site as two operable units (OUs). OU 1 includes the lagoon and former plant facility, which has been addressed separately. The record of decision for OU 2 was signed on March 8, 1996. During land treatment, the soil for each of three lifts was placed 4 to 12 inches thick in the land treatment area and inoculated with PAH-degrading microorganisms. An inoculum was sprayed on the soil and the land treatment area was cultivated once every two weeks. An irrigation system was used to maintain a 10-percent soil moisture content. The concentration of microorganisms in the soils was found to be adequate to support biological activity, and no inoculum was applied for the second or third lift. Additionally, the total number of lifts applied to each subplot varied because several of the half-acre areas exceeded the TCIC concentrations of 100 mg/kg. Subsequently, no additional soil was placed in those subplots until the analytical results indicated less than 100 mg/kg. On October 17, 1998, the PRPs provided a written report that the remedial action has been fully performed and the performance standards of the consent decree have been attained. As specified in the ROD, the PRPs will continue semiannual monitoring of groundwater through 2002 to confirm that groundwater will not be adversely impacted by the land treatment activities.

4-2. Introduction.

a. The introduction should include a brief description of the location, size, environmental setting, and history of the site. The site history should describe the operations and waste management practices that contributed to the contamination of the site, and the regulatory and enforcement activities that have occurred. The introduction should also discuss the major

findings and results of SI and RI activities. Any prior removal and remedial activities that have occurred at the site should be described. Any other OUs that have been designated at the site should be discussed and the OU addressed by the RA report should be introduced. An example introduction is provided in Exhibit 4-2.

b. Because the introduction provides background information on the entire site, most of it could also be used as the introduction of the RA report for other OUs at the site. The information for the introduction can be taken from reports prior to the RD or RA, such as the RI/FS or ROD.

Exhibit 4-2
Example Introduction (Section 1)

The U Creosote Superfund Site is located approximately two miles from the City of Live Oak, Suwanee County, Florida, at the intersection of Sawmill Road and Goldkist Road. Homes, businesses, light industry, a trailer park, a private airport, and a county storage yard are located within one-half mile of the site. Approximately 450 people live in the trailer park. Sinkholes and public and private wells lie within two miles of the site.

From 1948 to 1986, the ABC company operated the U Creosote site as a lumber treatment facility. Lumber treatment processes included the pressure-treatment of lumber products, mainly with creosote and occasionally with pentachlorophenol (PCP). Small rail cars were used to move lumber to two treatment cylinders. A mixture of either creosote and water or PCP and petroleum was used to treat the lumber. The treated lumber was dried on racks over bare soil and stored in an area north of the treatment cylinders.

Wastewater from the treatment cylinders was discharged to an oil-water separator. The creosote recovered from the oil-water separator was sent to a storage tank for reuse. If the creosote was determined to be off specification, it was sent to a spent creosote storage tank and properly disposed of at an off-site location at a later date. Wastewater from the oil-water separator discharged through a culvert and a drainage ditch to an unlined three-acre lagoon located in the southwest corner of the site.

In 1989, a former owner of the facility notified Region 4 of the U.S. Environmental Protection Agency (EPA) that hazardous materials may have been handled at the site. In response, the Florida Department of Environmental Regulation (FDER) conducted sampling at the site in July 1990. The results showed that soil and sludge in the area of the treatment cylinders were contaminated with a number of organic compounds and that the treatment cylinders contained small amounts of solidified creosote and PCP. In addition, creosote was found in the lagoon and the storage tanks. No contamination was detected in the aquifer underlying the site. EPA proposed in December 1990 that the site be placed on the National Priorities List (NPL). The listing of the site became final in September 1991.

The potentially responsible parties (PRP) conducted a remedial investigation and a feasibility study (RI/FS) at the site between 1992 and 1996 under the terms of a Federal administrative order on consent (AOC). Testing during that time confirmed that soils and sediments in the lagoon and drainage ditch were contaminated with polycyclic aromatic hydrocarbons (PAH). During the RI/FS, EPA and the PRPs agreed to address the site as two operable units (OU), OU1 and OU2.

OU1 included the lagoon and the former plant facility. Cleanup activities were completed in March 1996, under a Record of Decision (ROD) signed on July 25, 1995. The lagoon was drained, contaminated sludge and sediment was excavated, and wastewater was treated and discharged to a publicly owned wastewater treatment facility. Highly contaminated sludge and soil were solidified on site.

A ROD for OU2 was signed March 8, 1996, which is the subject of this report.

4-3. Operable Unit Background. This section should summarize the requirements specified in the ROD for the subject OU. It should include information on the cleanup goals, institutional controls, monitoring requirements, O&M requirements, and other parameters applicable to the design, construction, operation, and performance of the RA. Additional information regarding the basis for establishing the cleanup goals/remediation objectives, including planned future land use, should be provided. A summary of the RD, including any significant regulatory or technical considerations or events occurring during the preparation of the RD, should also be included in this section. Any ROD amendments, explanation of significant differences, or technical impracticability waivers should also be identified and briefly discussed. An example background section is provided in Exhibit 4-3.

Exhibit 4-3
Example Operable Unit Background (Section 2)

The remedy described in the ROD for OU2 included:

- On-site biodegradation of remaining, less-severely contaminated soils in a land treatment area constructed with a liner, internal drainage, and spray irrigation system;
- Activities necessary to the proper functioning of the land treatment process;
- After treatment, covering the land treatment area with clean fill and re-vegetating; and
- Five years of groundwater monitoring to verify that it remains uncontaminated.

The remediation objectives in the ROD were: Within two years from initial seeding, the land treatment process must reduce the concentration of TCIC to 100 mg/kg throughout the volume of the material treated. The goals were based upon a risk assessment that focused on attaining at least a 1×10^{-6} risk for ingestion of contaminated soil by a child. The risk assessment assumed a future industrial land use scenario, with no institutional controls. Remediation objectives were described by the total concentration of six carcinogenic indicator constituents of creosote -- benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenzo(a, h)anthracene, and indeno(1,2,3-c,d)pyrene – referred to as total carcinogenic indicator chemicals (TCIC). EPA selected the six of the approximately two hundred compounds that make up creosote because of their concentrations in sludge and soil at the site and their carcinogenic nature. The concentrations of TCIC in the soil to be treated ranged from 100 to 208 mg/kg.

The September 15, 1996, ROD amendment included:

- Soils contaminated at levels exceeding 100 mg/kg, but less than 5,000 mg/kg TCICs, were to be biodegraded in the on-site land treatment area.
- Soils found contaminated at levels exceeding 5,000 mg/kg TCICs were to be removed, stabilized, and disposed of at an EPA-approved hazardous waste disposal facility along with the solidified, OU 1 waste (7,500 yd^3).
- If the land treatment process did not attain the remediation objectives for the TCIC within two years, but quarterly monitoring showed substantial progress toward meeting the remediation objectives, EPA would consider extending the treatment period. However, if substantial progress could not be identified, EPA would consider alternative means of addressing the contaminated soils, such as capping, removal, incineration, solidification, or vitrification.
- Groundwater monitoring would begin upon completion of construction of the land treatment area.

Based on the original ROD and the ROD amendment, the remedial design was prepared for construction of the remedy. The design was completed in five months and approved by EPA September 15, 1996, for implementation of the remedial action.

4-4. Construction Activities. This section should provide a step-by-step description of the activities undertaken to construct and implement the RA (e.g., mobilization and site preparatory work; construction of the treatment system; associated site work, such as fencing and surface water collection and control; system operation and monitoring; and sampling activities). If a treatment technology was used, reference should be made to the appropriate appendix that reports factors affecting cost and performance of the system (e.g., site conditions, matrix characteristics, and operating parameters). An example construction activities section is provided in Exhibit 4-4.

Exhibit 4-4
Example Construction Activities (Section 3)

Site Preparation

Site preparation activities included clearing, grubbing, and grading the land where the land treatment area was to be constructed; building a drainage swale around the land treatment area; preparing a temporary, central soil stockpile area consisting of several lined cells; and installing a perimeter fence with signs warning against exposure to hazardous material. Approximately four acres were cleared. An estimated 200 cubic yards of contaminated soil found to contain less than 5,000 mg/kg TCICs were excavated during the site preparation activities and stored in the central stockpile area along with previously excavated, contaminated soil.

Off-Site Disposal of the Solidified, Operable Unit 1 Waste

To dispose of the 7,500 cubic yards of solidified OU 1 waste, a suitable receiving facility in Emelle, Alabama, operated by Chemical Waste Management, Inc. (CWM), was identified. The waste was shipped off-site to the facility in Emelle on December 1, 1996.

Construction of the Land Treatment System

A clay layer ranging from one to three feet in thickness was installed throughout the four-acre land treatment area. The clay was taken from a borrow pit located elsewhere on the site. The borrow pit was shaped and used as a 750,000-gallon retention pond for collecting water and leachate from the land treatment area. Compacted clay berms were placed around the land treatment area and around the soil stockpile area. Swales were installed outside the treatment area to intercept and redirect run-on.

The land treatment area was prepared with a one percent slope to the northwest corner, where the subsurface drainage system drained under the berm into a gravel-lined swale that led to the retention pond. The drainage system consisted of 12-inch-wide, flat, perforated pipe laterals, spaced every 50 feet in an east-to-west direction. The pipes connected to a south-to-north drainage trench containing cylindrical, perforated piping sloping to a sump in the northwest corner of the land treatment area. The entire subsurface drainage system was covered with a minimum of six inches of clean, sorted sand. Finally, a portable irrigation system, delivering water at 0.5 inches per hour to an area 70 feet in diameter, was installed at the retention pond, which recirculated the collected water and sprayed the water over the land treatment area.

System Operation

Land treatment was performed in three lifts, with a total of 8,100 yd^3 of soil treated: 3,300 yd^3 (Lift 1); 3,000 yd^3 (Lift 2); and 1,800 yd^3 (Lift 3). For site management and sampling purposes, the land treatment area was divided into eight half-acre, rectangular subplots. A composite sample was collected from each subplot each quarter, until the concentration of TCICs in the soil in the subplot was less than 100 mg/kg. An additional lift of soil from the stockpile area then was placed in the subplot. The process was repeated until all of the stockpiled soil had been placed in the land treatment area.

Exhibit 4-4, cont.
Example Construction Activities (Section 3)

In general, the soil for each lift was placed 4 to 12 inches thick in the land treatment area and inoculated with PAH-degrading microorganisms. The inoculum, sprayed on the soil, was developed by growing seed cultures in mobile, on-site reactor tanks equipped with aeration and mixing equipment. The land treatment area was cultivated once every two weeks. An irrigation system was used to maintain a 10-percent soil moisture content. The concentration of microorganisms in the soils at the land treatment area was found to be adequate to support biological activity, and no inoculum was applied for the second or third lift. Additionally, the total number of lifts applied to each subplot varied because several of the half-acre areas exceeded the TCIC concentrations of 100 mg/kg. Subsequently, no additional soil was placed in those subplots until the analytical results indicated less than 100 mg/kg.

Appendix A reports matrix characteristics and operating parameters of the land treatment system.

Approximately 50 cubic yards of construction debris were removed from the soil and buried on the site. After validation of the final sampling results and determination that the remediation objectives had been met, the site was backfilled with clean soil and seeded on September 1, 1998.

4-5. Chronology of Events. This section should provide a tabular summary that lists the major events for the OU, and associated dates of those events, starting with the ROD signature. The table should include significant milestones and dates, including: RD submittal and approval; ROD amendments; mobilization and construction of the remedy; treatment system/application start-up; monitoring and sampling events; system modifications; operational down time; variances or non-compliance situations; date of final shut-down or cessation of operations; final sampling and confirmation-of-performance results; required inspections; demobilization; and RA completion or startup of post-RA O&M activities. If an O&F period applies, indicate the start and end dates. For interim RA reports, indicate when cleanup goals are estimated to be achieved. An example chronology is provided in Exhibit 4-5.

Exhibit 4-5
Example Chronology of Events (Section 4)

Date	Event
March 8, 1996	ROD for OU2 signed.
August 3, 1996	Remedial Design (RD) submitted.
September 15, 1996	RD approved; ROD amendment signed.
September 29, 1996	RA contract awarded.
October 3, 1996	Construction of the land treatment area began, including excavation of contaminated soil..
December 1, 1996	Solidified waste from OU1 transported and disposed of off-site.
December 12, 1996	PRPs, EPA, and the State conduct pre-final inspection of the land treatment area.
January 12, 1997	PRPs, EPA, and the State conduct final inspection of the land treatment area.
January 19, 1997	Operation of land treatment area begun; first lift of soil applied to treatment subplots; sampling of soil in treatment plots begun.

Exhibit 4-5, cont.
Example Chronology of Events (Section 4)

Date	Event
January 20, 1997	Semiannual groundwater monitoring initiated .
June 12, 1997	Preliminary Close Out Report for site signed for site construction completion.
September 15, 1997	Second lift of soil applied to treatment subplots.
March 14, 1998	Third lift of soil applied to treatment subplots.
June 28, 1998	Final sampling of soil in treatment subplots and in other designated site areas conducted.
July 24, 1998	Final soil sampling results validated; remediation objectives achieved.
September 1, 1998	Land treatment area demobilized and re-vegetated.
September 22, 1998	PRPs, EPA, and the State conduct pre-certification inspection of the completed remedial action.
Ongoing	Semiannual groundwater monitoring. Expected to continue through 2002.

4-6. Performance Standards and Construction Quality Control.

a. This section should describe the overall performance of the remedial technology in terms of a comparison to cleanup goals/remediation objectives. For treatment remedies, this section should identify the quantity of material treated, the strategy used for collecting and analyzing samples, and the overall results from the sampling and analysis effort. An explanation of the approved construction quality assurance (QA) and quality control (QC) requirements, or citations for the appropriate references, should be provided. An explanation of any substantial problems or deviations should be included.[1] An assessment of the performance data quality and of the overall analytical data quality should be provided, including a brief discussion of the QA/QC procedures followed, the quality assurance project plan (QAPP) used, and the data quality objectives (DQOs) to which the analytical data were compared. For PRP-lead projects, a discussion should be provided of EPA's oversight activities and results with regard to analytical data quality. An example section is provided in Exhibit 4-6.

b. Specific topics to consider for this section include sample frequency and protocol, concentrations of untreated vs. treated contaminants, comparison with cleanup goals, methods of analysis, and treatment residues. More detailed information on documenting technology performance is provided in Chapter 5 of this guide (Paragraph 5-1).

[1] Note that changes to the remedy selected in the ROD that occurred during the RD/RA process must be described in an Explanation of Significant Differences (ESD) or a ROD Amendment pursuant to NCP §§300.435(c)(2) and 300.825(a) that is provided separately from the RA report.

Exhibit 4-6
Example Performance Standards and Construction Quality Control (Section 5)

Performance Standards

The quantity of soil treated by landfarming was 8,100 yd^3. Initial concentrations of PAHs in untreated, stockpiled soil ranged from 100 to 208 mg/kg. Upon completion of land treatment, the concentration of TCICs in soil ranged from 23 to 92 mg/kg.

All soil and sludge samples collected during operation of the land treatment area were analyzed for PAHs. EPA Method 8270 was used to measure the concentrations of PAHs in all samples. Composite samples were collected quarterly from eight subplots in the land treatment area over an 18-month operating period. Once the cleanup goal had been achieved in a subplot, that subplot was not monitored further until an additional lift of soil was applied to the subplot.

Performance Results Compared with Remediation Objectives

Remediation Objectives	Performance Results
Reduce concentration of TCICs to 100 mg/kg.	Sampling conducted in June 1998 indicated that the concentration of TCICs was less than 100 mg/kg and ranged from 23 to 92 mg/kg in the eight subplots.
Attain desired remediation objectives within two years after startup of the land treatment operation.	Cleanup levels were attained within 18 months after startup of the land treatment operation.
Identify, remove, stabilize, and dispose (off-site) of excavated OU 2 soils with TCIC levels greater than 5,000 mg/kg.	Sampling detected no soils with contamination above this specified level.

Quality Assurance and Quality Control

The QA/QC program used throughout the operation of the land treatment area was outlined in the RD/RA work plan and quality assurance project plan (QAPP) approved by EPA. The program enabled EPA to determine that all analytical results reported were accurate and adequate to ensure satisfactory execution of the remedial action, in a manner consistent with the requirements of the ROD.

The RA contractor conducted sampling and analysis activities on the soils each quarter. EPA took split samples during three sampling events, including the final sampling event on June 28, 1998. EPA periodically conducted oversight of the PRP contractor's field sampling procedures. While deviations from the approved protocols were identified, none was sufficiently significant to cause rejection of the data. Matrix spike, duplicate, and blank samples were analyzed by the laboratory, and the resulting data provided to EPA. On the basis of the split sample data, the confirmatory sampling data were acceptable to EPA. The Florida Department of Environmental Regulation (FDER) also reviewed the data and found the data to be acceptable.

The QA/QC program is also being used for the semiannual sampling of groundwater.

4-7. Final Inspections and Certifications. This section should report the results of the various RA contract inspections, and should identify any noted deficiencies. Adherence to health and safety requirements while implementing the RA should be described briefly. Any substantial problems or deviations should be explained. This section should summarize details of the institutional controls, if implemented, (e.g., the type of institutional control, who will maintain the control, and who will enforce the control). For PRP-lead projects, a description of the pre-certification inspection results should be included. If applicable, the date that the remedy was determined to be O&F should also be included. An example section is provided in Exhibit 4-7.

Exhibit 4-7
Example Final Inspections and Certifications (Section 6)

Inspections

The pre-final inspection of the land treatment area construction was held on-site December 12, 1996, in the presence of EPA, PRP, and FDER representatives. The FDER representative noted the need to fence the lagoon for the protection of the public, and a fence was constructed around the lagoon area.

The final inspection was conducted January 12, 1997. EPA, the PRPs, FDER, the Florida Department of Health and Rehabilitative Services (FDHRS), the Suwanee County Coordinator, and the Mayor of Live Oak were present.

Representatives verified by review of the manifests that the 7,500 cubic yards of solidified OU1 waste had been properly transported and disposed off-site at the CWM landfill in Emelle, Alabama. No punch-list items were identified, and land treatment of the stockpiled contaminated soil was authorized to begin immediately.

Observations, inspections, and testing during operation of the land treatment process found no significant operational problems affecting the performance of the remedial action. A business east of the site reported experiencing nuisance smells after the contaminated soils in the land treatment area were tilled. In response, an effort was made to till when the wind direction was away from the businesses to the east of the site. No further comments about odors were received during the land treatment operation.

Health and Safety

No health and safety problems were encountered during construction or operation. Modified Level D personal protective equipment (PPE) was required for all site personnel who came into direct contact with the contaminated soil. The equipment included coveralls, safety boots, nitrile gloves, and particulate masks.

Certification of Completion

A pre-certification inspection of the completed remedial action was conducted on September 22, 1998, by representatives of the PRPs, EPA and the FDER. On October 17, 1998, the PRPs provided a written report that the remedial action has been fully performed and the performance standards of the consent decree have been attained.

4-8. Operation & Maintenance Activities. This section should describe the general activities included as post-construction O&M, such as monitoring, site maintenance, and closure activities. This can include both short-term (RA operating) and long-term (post-RA) O&M. Information regarding any LTRAs and PRP LRs should also be included in this section. Any potential problems or concerns with these activities should be identified here. The results of any optimization efforts during O&M should be noted. If an interim RA report is being completed, the future groundwater or surface water restoration activities should be described. An example O&M activities section is provided in Exhibit 4-8.

Exhibit 4-8
Example Operations & Maintenance Activities (Section 7)

The land treatment area was grass-seeded in September 1998. The vegetative cover will be reseeded in Spring 1999 as necessary.

The semiannual groundwater monitoring program began in January 1997. No TCICs have been detected as of the July 1998, sampling; however, naphthalene has been detected persistently at low levels in groundwater monitoring well No. 7. The levels of naphthalene are below any action level. As specified in the ROD, the PRPs will continue semi-annual monitoring of groundwater through 2002 to confirm that groundwater will not be adversely impacted by the land treatment activities.

4-9. Summary of Project Costs.

a. This section should present the total costs incurred for the remedial action. These costs can be designated as capital, O&M, or periodic costs, as described in Chapter 6. Further, these costs can be designated as RA or post-RA costs (e.g., RA capital costs, RA operating costs, post-RA O&M costs).

b. The reporting of project costs is required for government-financed projects and should be provided whenever possible for PRP-lead projects. If the project is PRP-lead, a summary of government oversight costs for the RD and RA should be included.

c. The year(s) in which costs were incurred should be indicated. If actual costs are not available, estimated costs should be provided (e.g., when pending claims may impact final cost).

d. Total project costs at the time of RA completion, actual or estimated, should be compared to the costs estimated in the ROD for the selected remedy, adjusted to the same dollar basis year. Adjustment can be made using an escalation factor, for which the index or rate used should be noted (e.g., Engineering News Record building cost index). If the total project costs lie outside a range of –30 to +50 percent of the ROD estimate, explanation for these differences should be included. An example summary of project costs is provided in Exhibit 4-9.

e. In addition to reporting total costs, a cost breakdown, identifying cost elements, should be provided in an appendix to the RA report. More detailed information on documenting project costs is provide in Chapter 6 of this guide.

Exhibit 4-9
Example Summary of Project Costs (Section 8)

The table below provides a summary of the total project costs and a comparison of the actual costs with the ROD estimate. Appendix B provides additional project cost breakdown.

Cost Summary

Cost Item	ROD Estimate (1996 $$)	ROD Estimate (1998 $$)[1]	Actual Cost (1998 $$)
RA Capital Cost	$266,000	$282,000	$303,026
RA Operating Cost	258,000	273,000	132,497
Total Cost	524,000	555,000	435,523
Projected Future O & M Cost[2]			21,000
Difference between total project cost and total ROD cost estimate[3]	-$119,000 or -22%		

[1] ROD Cost was adjusted from 1996 $$ to 1998 $$ using average 1996 and 1998 ENR building cost index factors.

[2] Groundwater monitoring was not included in original ROD. Assumed length of monitoring = 5 years

[3] Difference between project cost and ROD estimate is largely attributable to 18 months of actual treatment instead of 24 months planned in the ROD.

4-10. <u>Observations and Lessons Learned</u>. This section should discuss site- or OU-specific observations and lessons learned, highlighting successes, problems and their resolutions. The discussion of the problems and their resolutions will be included in the useful technical information that will be extracted by the government and compiled for use in future remedy selections. The information presented should be technical in nature and specific to the site. Observations or lessons learned relating to both cost and performance of the remedial action are important to note. An example section is provided in Exhibit 4-10.

Exhibit 4-10
Example Observations and Lessons Learned (Section 9)

- The project cost 22% less than the adjusted ROD estimate, largely due to reduced labor and materials costs associated with achieving remediation objectives in 18 instead of 24 months. Use of an on-site laboratory also contributed to savings.
- The land treatment application was found to be more effective at remediating soils on the site when the soils were tilled once every two weeks, rather than once every four weeks, as was originally planned.
- Application of fertilizers to the soils at the site proved to be unnecessary because of the naturally high concentrations of inorganic nitrogen and phosphorous in the soil.

Exhibit 4-10, cont.
Example Observations and Lessons Learned (Section 9)

- The relatively mild year-round temperatures at the site provided a beneficial growing environment for the inoculum of PAH-degrading microorganisms. Consequently, relatively high numbers of microorganisms remained in the soil, thus reducing the need for repeated soil inoculations.
- Soils at the site were difficult to till after heavy rains. Natural drying of the soil took an average of two weeks before tractors could be operated on the land treatment area.
- Nuisance odors were reported on days when soils were tilled. Therefore, measures were taken to till on days when the wind direction was away from neighboring properties.

4-11. <u>Operable Unit Contact Information</u>. This section should provide contact information (names, addresses, phone numbers, and contract reference data) for the major design and remediation contractors and subcontractors, oversight contractors, and the respective project managers for the government and the PRPs, as applicable. If available, O&M contact information should be included, such as the prime O&M contractor, subcontractors, and oversight contractors. Contract numbers for the RA and O&M should also be listed, if available. If all available information has already been provided as part of the abstract, this section may be excluded from the RA report. Example information blocks are shown in Exhibit 4-11.

Exhibit 4-11
Example Operable Unit Contact Information (Section 10)

Remedial Action Contractor:

Primary Contact Name and Title:

Company Name:

Address:

Phone Number:

RA Oversight Contractor:

Company Name: *Contract Number:*

Address:

Phone Number: *Work Assignment Number:*

Analytical Laboratory*:*

For the PRPs:

Company Name:

Address:

Phone Number:

Exhibit 4-11, cont.
Example Operable Unit Contact Information (Section 10)

For the government: *Contract Number:* *Company Name:* *Address:* *Phone Number:*
Project Management: For the PRPs: *Name:* *Company Name:* *Address:* *Phone Number:* For the government: *Name:* *U.S. EPA Region:* *Address:* *Phone Number:*

4-12. <u>References</u>. All references used in preparing the RA report, as well as key documents relating to the RA, should be listed in the references section of the RA report. Examples of documents to reference include the ROD, ROD amendment, remedial design documents, key correspondence/deliverables during the RA, and as-built drawings.